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Expenditure on education in Purchasing Power Standards

A comparison of three alternative deflators

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Abstract

Following the conclusions of the IEG Indicator Expert Group on Education Expenditure the main recommended indicator to compare expenditure on education across countries is based on the expenditure per capita (students in full time equivalent –FTE) and corrected using purchasing power parities (PPP) as convertor unit. The election of PPP is based on its two main characteristics: a) it is a currency convertor able to transform different currencies to a common currency; and b) it is a spatial price deflator, that is, it equalizes purchasing power eliminating differences in price levels. However, different approaches could be used to calculate PPP in order to standardized expenditure values (Eurostat-OECD, 2012): PPP in GDP, PPP in actual individual consumption (AIC) and PPP in actual individual consumption of education (AICE). This report focuses on a) the comparison of the basket elements of goods and services of the three deflators, b) the analysis of education expenditures per student in purchasing power standards (PPS) across Member States (MS) at different levels; and c) the assessment of the quality adjustment factor included in the PPP Education based on PISA scores. Results suggest that the selection of the deflator matters when purchasing power parities are used in international expenditure comparison. In particular, while PPP in GDP is the traditional deflator used, PPP in AIC provides a better measure of economic activity for comparisons of material well-being of household. However the application of PPP Education significantly changes the expenditure distribution picture of EU MS. On the other hand, the inclusion or exclusion of the quality-adjustment (measure through PISA scores) to calculate PPP Education does not change the relative position of the EU MS in the expenditure distribution, but it is a recommended approximation to control for the different qualities of education outputs as an outcome of the state of knowledge of a population of pupils estimated by scores obtained.

1 Introduction

Over the past several decades, new ways of comparing global development levels across countries have been developed to overcome deficiencies in the use of nominal exchange rates. In order to guarantee spatial comparability, the Eurostat-OECD Purchasing Power Parity (PPP) Programme was established in the early 1980s to compare on a regular and timely basis the GDPs of the Member States (MS) of the European Union and the Member Countries of the OECD. PPPs serve both as currency convertors and as spatial price deflators. They convert different currencies to a common currency and, in the process of conversion, equalize their purchasing power by eliminating the differences in price levels between countries. In their simplest form, PPPs are simply price relatives that show the ratio of the prices in national currencies of the same product in different countries. Thus, when the GDPs and component expenditures of countries are converted to a common currency with PPPs, they are valued at the same price level and so reflect only differences in the volumes of goods and services purchased.

Although the theory of PPP has come to be generally accepted, several technical issues still exist that require redress. One major problem has been and continues to remain that non-market services are difficult to measure. Education is primarily a non-market service with the majority of students receiving education at prices that are not economically significant or sometimes for free from non-market procedures. This means that education, as other non-market services, is considered to be comparison resistant because a) there are no economically-significant prices with which to value output and b) units of output are difficult to define and measure due to the differences in the quality output between countries.

In order to face these shortcomings, Eurostat and OECD propose different alternatives to solve these limitations (Eurostat-OECD, 2012). Specifically, and taking into account the purpose of this briefing, the work will focus on two alternatives to dismiss the limitations of non-market services measures. On the one hand, although GDP can be seen as one of a family of indicators that are to be developed to monitor overall social progress as well as the specific elements that constitute well-being, it is not necessarily the best national accounting aggregate for this purpose. Not only does it cover the goods and services that resident households consume to satisfy their individual needs, it also includes services, such as defence, police and fire protection, that government produces to meet the collective requirements of the community, as well as gross capital formation and net exports neither of which constitute final consumption. Recent communications suggest that a better measure of material well-being is the aggregate *actual individual consumption* (AIC).[1] This comprises only the goods and services that households actually consume to satisfy their individual needs. It covers all such goods and services irrespective of whether they are purchased by the households themselves or are provided as social transfers in kind by government and non-profit institutions serving households (NPISHS).

On the other hand, and particularly in the case of education, Eurostat and OECD are currently calculating a specific PPP for Education (from now onwards PPP Education) using the output method that makes no distinction between market and non-market procedures. The output method is based on individual consumption of education instead of purchases and complemented by the quality adjustment that serves to control for changes in the teaching services provided that cannot be captured by differentiation across levels of education only. The individual consumption expenditures on education by households, by non-profit making institutions serving households and by general

[1] This concept, or its equivalent, has been used in international comparisons of GDP based on PPPs since the 1950s. It was not until the 1990s that it was adopted by national accountants and included in the international system of national accounts.

government are added together to obtain *actual individual consumption of education* (AICE). For the national accountant, the output measure of education take into account the quantity of teaching provided by the producers of education, the quality of the education provided by their producers and the level and the field of education for which the education is provided. Or in other words, AICE is calculated on the basis of quality-adjusted expenditure per student at each ISCED level as unit prices and total expenditure for each ISCED level as weights. However measuring the quality of education is not so straightforward. Currently PPP Education is adjusted using PISA scores because it is considered as a measure of the level of skills and knowledge of 15 years-old students. The theoretical argument behind this is that, although an imperfect measure of quality, once PISA scores are corrected or adjusted by the impact of family and social environment, the output measure is only reflecting the skills and knowledge transferred by the school through formal education.

Following the conclusions of the IEG Indicator Expert Group on Education Expenditure the main recommended indicator to compare expenditure on education across countries is based on the expenditure per capita (students in full time equivalent –FTE-) and corrected using purchasing power parities (PPP) as convertor unit. The election of PPP is based on its two main characteristics: a) it is a currency convertor able to transform different currencies to a common currency (the natural choice for data on EU MS is the Euro); and b) it is a spatial price deflator, that is, it equalizes purchasing power eliminating differences in price levels. However, different approaches could be used to calculate PPP in order to standardized expenditure values (Eurostat-OECD, 2012).

This report uses as essential material the OECD-Eurostat (2012) Manual. It is a methodological report on PPPs and describes the organisation of the work and the data collection, validation and calculation methods. The manual has three specific objectives: first, to provide essential methodological guidelines on the international price and volume comparisons of GDP to those directly engaged in the Programme; second, to communicate effectively on the objectives and outcomes of the Programme to key users and importantly, to advise these users on the use and interpretation of comparison results; and third, to provide a single point of reference on the Eurostat-OECD PPP Programme, accessible to teachers, students and the general public interested in PPPs and related statistics.

1.1 Aims of the current technical briefing

The main objective of this report is then to compare government education expenditures (referred as education expenditures from now onwards) across EU MS when different conversion units[2] are applied. The three deflators selected to analyse here are:

Purchasing Power Parities based on GDP (PPP in GDP from now onwards): this is the traditional convertor unit used for international comparisons. It is based on the expenditure approach and includes the same basket of goods and services as the GDP.

Purchasing Power Parities based on actual individual consumption (PPP in AIC): because the delivery of particular services such as health or education differs across countries, specific adjustments for government services are required to avoid misleading in the international comparisons of household expenditure. This deflator is based on what households actually consume as opposed to what they purchase and constitutes a measure of the average household material well-being (OECD, 2013).

Purchasing Power Parities based on Education outputs (PPP Education): because education is a non-market service, the expenditure on education provided by non-market producers cannot be derived as it is for market producers by summing their sales. The individual consumption expenditures on education by households, non-profit

[2] By 'conversion units' or 'deflators' we refer to the different approaches and methodologies used to calculate purchasing power parities.

marking institutions serving households, and by general government are added together to obtain actual individual consumption of education (AICE). This specific deflator compares what households actually consume rather than what they purchase and is based on a measure of output composed by: quantity of teaching provided (number of students in FTE), quality of education provided by their producers (based on PISA[3] scores) and the level and field of education for which education is provided.

According to this, the briefing has three main objectives:

- Objective 1: From a methodological point of view, the briefing will provide a comparison between the basket elements of goods and services included in the construction of PPP, PPP in AIC and PPP Education deflators.
- Objective 2: From an empirical point of view, the briefing will compare education expenditures per student in purchasing power standards (PPS) across MS at different levels.
- Objective 3: The third objective relates to the assessment of the quality adjustment factor included in PPP Education based on PISA scores.

In order to fulfil these objectives, the rest of the briefing is organized as follows: next section summarizes the main changes in the deflators used (from exchange rates to PPP), the main policy regulations defining PPP as well as a revision of PPP deflators comparing the basket elements included in each type of convertor unit. Section 3 includes the empirical analysis of the document where education expenditures across MS are compared when the different deflators are applied. Section 4 focuses on PPP Education to assess the deflator when a quality adjustment is/is not applied. Finally, Section 5 concludes.

[3] The Programme for International Student Assessment (PISA) managed by the OECD.

2 Calculating PPP

The International Comparison Program (ICP) collects prices in countries around the world, and uses them to calculate price index numbers or purchasing power parities (PPP), whose aim to measure how much local currency is needed to buy as much as does the currency in the numeraire country. As with price indexes within a country, PPPs can be thought of as statistical averages of prices, or given a cost-of-living interpretation. They are also used to deflate nominal local currency measures to yield "volume" measures expressed in a common currency unit, such as current US dollars for the year of the comparison or EUR in the case of the EU.

2.1 From exchange rates to PPP

Exchange rates were used to make international comparisons of GDP before PPPs became available. Their use was underpinned by the theory of purchasing power parity in international economics. In its simplest form, the theory suggests that national price levels converted to a common currency using exchange rates should be equal. Arbitrage will ensure that the price of an individual good will be the same in all countries in which it is traded – the law of one price. Hence, when the individual goods are taken together, there will be high correlation in general price levels – at least in the medium and long term. The two principle assumptions underlying the theory are that all goods are internationally tradable and that the demand and supply for currency is driven entirely by international trade in goods.

Exchange rates are determined by the supply and demand for different currencies. But the supply and demand for currencies are influenced by factors such as currency speculation, interest rates, government intervention and capital flows between countries rather than by the currency requirements of international trade. Moreover, some goods and services, such as buildings, government services and some market services, are not traded internationally. For these reasons, exchange rates do not reflect the relative purchasing powers of currencies in their national markets. Hence, while exchange rates provide GDP estimates that satisfy the condition of being expressed in the same currency unit, they do not provide GDP estimates that satisfy the condition of being valued at the same price level. Or in other words, nominal exchange rates are not suitable conversion factors in such comparisons, because they do not adequately reflect price level differences, and because they are not sufficiently stable over time[4].

The solution is to apply purchasing power parities (PPPs). A PPP is defined as the number of units of country B's currency that is needed in country B in order to purchase the same quantity of goods and services that one unit of country A's currency will purchase in country A. PPPs can thus be interpreted as the exchange rate of an artificial currency commonly referred to as the purchasing power standard (PPS). If the expenditures of countries A and B expressed in national currencies are converted into PPS, the resulting figures are expressed in the same price level and the same currency, allowing a meaningful comparison of volumes. PPPs for market goods and services are based on international price surveys. Such price surveys are carried out simultaneously in all participating countries, based on a common product sample.

2.2 Policy regulations and Institutions involved

The European Commission and specifically Eurostat are responsible for calculating PPPs for the Member States in accordance with the following regulations:

- Regulation (EC) No 1445/2007 of the European Parliament and of the Council of 11 December 2007 establishing common rules for the provision of basic

[4] Information extracted from the Standing Group on Indicators and Benchmarks in April 2015.

information on Purchasing Power Parities and for their calculation and dissemination[5].

- Commission Regulation (EU) No 193/2011 of 28 February 2011 implementing Regulation (EC) No 1445/2007 of the European Parliament and of the Council as regards the system of quality control used for Purchasing Power Parities[6].

In addition there is a report from the Commission to the European Parliament and the Council on the implementation of Regulation (EC) No 1445/2007 of the European Parliament and of the Council of 11 December 2007 establishing common rules for the provision of basic information on Purchasing Power Parities and for their calculation and dissemination[7].

These regulations provide specific definitions of PPP:

Purchasing Power Parities (PPPs):

Spatial deflators and currency converts that eliminate the effects of the differences in price levels between MS thus allowing volume comparisons of GDP components and comparisons of price levels.

Purchasing Power Standard (PPS):

The artificial common reference currency unit used in the EU to express the volume of economic aggregates for the purpose of spatial comparisons in such a way that price level differences between MS are eliminated.

Actual Individual Consumption (AIC):

All goods and services actually consumed by households. It encompasses consumer goods and services purchased directly by households, as well as services provided by non-profit institutions and the government for individual consumption (e.g., health and education services).

In practice, these PPP calculations are embedded in a wider PPP program coordinated jointly by Eurostat and OECD. PPP shall be calculated from the national annual average prices of goods and services, using basic information relating to the economic territory of the MS as provided by the European system of the national and regional accounts (ESA 2010). PPP should be calculated in accordance with the basic headings. The basic heading is defined as the lowest level of aggregation in the expenditure breakdown for which PPPs are calculated. Ideally, a basic heading covers a group of similar well-defined goods or services. In practice, the coverage of a basic heading is often determined by the lowest level of final expenditure for which explicit expenditure weights can be estimated. Hence, a basic heading can comprise a cluster of diverse product groups instead of the theoretically-preferable group of similar products.

2.3 The basket elements of goods and services in PPP

This section presents the basket elements of goods and services included in each methodology to calculate PPP in GDP, PPP in AIC and PPP Education.

[5] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:336:0001:0024:EN:PDF
[6] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0193&from=EN
[7] http://ec.europa.eu/eurostat/documents/64157/4375784/06-Purchasing-Power-Parities-2013_EN.pdf/bd3488ba-3fad-45b6-b3b2-117d9bc61de9

2.3.1 PPP in GDP

PPP in GDP uses the same basket elements of goods and services as GDP. Using the RGULATION (EC) No 1445/2007, the basic headlines included in the calculus are:

- Individual Consumption Expenditure by Households:
- Individual Consumption Expenditure by non-profit institutions [8] serving households
- Individual Consumption Expenditure by government
- Collective consumption expenditure by government
- Expenditure on gross fixed capital formation
- Changes in inventories and acquisitions less disposals of valuables
- Balance of exports and imports

These seven main aggregates are broken down into 31 expenditure categories, 66 expenditure groups, 143 expenditure classes and 206 basic headings[9] (Table 1). Of these aggregation levels, the basic heading level is particularly important because it is at this level that expenditures are defined, products selected, prices collected, prices edited and PPPs first calculated and averaged[10]. The resulting set of transitive PPPs for all countries and all basic headings are aggregated up to the level of total GDP using expenditures from national accounts as weights. The calculation is made in three stages. The first is at the product level, where price relatives are calculated for individual goods and services. The second is at the product group level, where the price relatives calculated for the products in the group are averaged, usually without weights, to obtain PPPs for the group. And the third is at the aggregation levels, where the PPPs for the product groups covered by the aggregation level are weighted and averaged to obtain weighted PPPs for the aggregation level. The weights used to aggregate the PPPs in the third stage are the expenditures on the product groups.

In principle, it would be desirable to weight the price relatives within product groups, but the expenditure data required to do this are not available generally. PPPs are not only calculated for individual goods and services, they are also calculated for product groups and for each of the various levels of aggregation up to and including GDP.

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[8] Government final consumption expenditure is broken down by purpose and by type of service in line with COFOG98 into individual consumption expenditure by government and collective consumption expenditure by government. Individual consumption expenditure by government is government expenditure on services which households consume individually (housing, health, recreation and culture, education and social protection). Collective consumption expenditure of government is government expenditure on services which benefit households collectively (general public services, defence, public order and safety, economic affairs, environment protection, and housing and community services).

[9] Eurostat and the OECD use the same classification of GDP expenditures. The classification follows the definitions, concepts, classifications and accounting rules of the SNA 934 and the ESA 955. The Eurostat version of the classification has 206 basic headings; the OECD version has 196. Eurostat's 206 sum exactly to the OECD's 196. The main difference between the two versions is that the OECD version has just one basic heading for furniture and one basic heading for nonprofit institutions serving households (NPISHs), whereas the Eurostat version has four basic headings for furniture and six basic headings for NPISHs.

[10] The classification of expenditure used for Eurostat and OECD comparisons of GDP differs slightly from the classification of the PPP Regulation because it has been updated to accommodate the methodological developments that have been introduced into the PPP Programme since 2007 and which have been in place since the end of 2011. The updating has reduced the number of basic headings for construction and education.

Table 1. Main aggregates included in the calculation of PPP in GDP

Main aggregates Categories	Categories	Groups	Classes	Basic headings
11.00 Individual consumption expenditure by households	**13**	**44**	**105**	**143**
- .01 Food and non-alcoholic beverages		2	11	34
- .02 Alcoholic beverages, tobacco and narcotics		3	5	5
- .03 Clothing and footwear		2	6	10
- .04 Housing, water, electricity, gas and other fuels		5	11	11
- .05 Furnishings, household equipment and maintenance		6	12	16
- .06 Health		3	7	7
- .07 Transport		3	14	18
- .08 Communication		3	3	3
- .09 Recreation and culture		6	20	22
- .10 Education		1	1	1
- .11 Restaurants and hotels		2	3	4
- .12 Miscellaneous goods and services		7	11	11
- .13 Net purchases abroad		1	1	1
12.00 Individual consumption expenditure by NPISHs	**6**	**6**	**6**	**6**
- .01 Housing		1	1	1
- .02 Health		1	1	1
- .03 Recreation and culture		1	1	1
- .04 Education		1	1	1
- .05 Social protection		1	1	1
- .06 Other services		1	1	1
13.00 Individual consumption expenditure by government	**5**	**6**	**11**	**21**
- .01 Housing		1	1	1
- .02 Health		2	7	17
- .03 Recreation and culture		1	1	1
- .04 Education		1	1	1
- .05 Social protection		1	1	1
14.00 Collective consumption expenditure by government	**1**	**1**	**5**	**7**
15.00 Gross fixed capital formation	**3**	**6**	**13**	**26**
- .01 Machinery and equipment		2	7	20
- .02 Construction		3	3	3
- .03 Other products		1	3	3
16.00 Change in inventories and acquisitions less disposals of valuables	**2**	**2**	**2**	**2**
-.01 Change of inventories		1	1	1
-.02 Acquisitions less disposals of valuables		1	1	1
17.00 Balance of exports and imports	**1**	**1**	**1**	**1**
GDP	**31**	**66**	**143**	**206**

Source: Eurostat-OECD Methodological Manual on Purchasing Power Parities

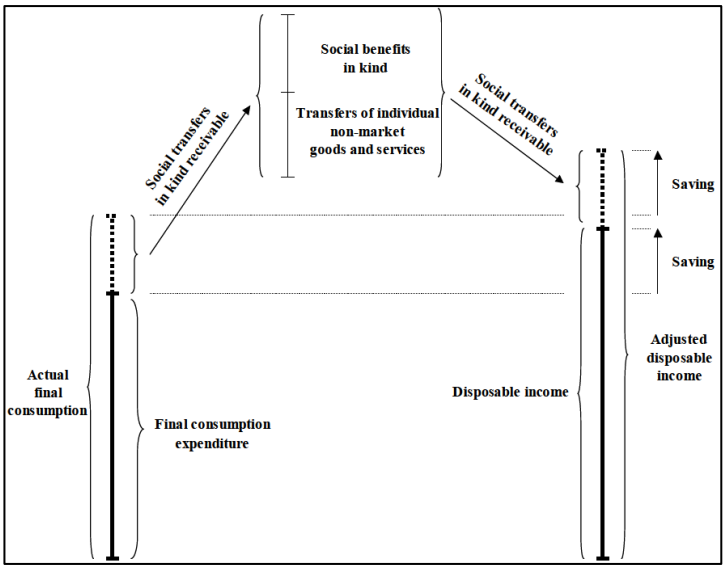
2.3.2 PPP in AIC

While GDP per capita is often considered as an indicator of a country's living standard, it is actually the sum of all goods and services produced in that country. As highlighted in the 'Report on the measurement of economic performance and social progress' (Stiglitz et al. 2009), actual individual consumption (AIC) per capita is an alternative indicator better suited to describe the material welfare situation of households as it takes account of widespread differences across countries in the shares of public financing for the provision of education and health services to individuals.

AIC is calculated as household consumption expenditure plus "individual consumption" which is the amount spent by general government and the NPISHs on things that directly benefit households, such as healthcare and education. Households do not pay directly for these services (they pay for them indirectly through taxes), but they benefit from them. International comparisons of consumption per head are meaningful only if based on actual individual consumption and not consumption expenditure. This is because there are significant differences between countries regarding the proportion of expenditure carried out directly by households for healthcare and education and the proportion carried out on their behalf by government. If one uses expenditure and not actual consumption, one falls into the trap of understating consumption per head in

countries that "socialise" this type of expenditure to a greater extent (the countries of western Europe in particular) compared with countries that leave this expenditure more to the private sector. In other words, AIC is a spatial deflator for adjusted disposable income for the calculus of PPP and, using the System of National Accounts, is composed by final consumption expenditure, that is the expenditure incurred by households on consumption products, plus some imputed expenditure items such as the imputed rents that house owners pay to themselves; and the value of social transfers in kind that households receive from governments. The value of these transfers is essentially measured by the costs that the government incurs to provide them to citizens. Graph 1 summarizes the definition of AIC.

Figure 1. Actual individual consumption (AIC) graphical definition



Source: Stiglitz et al. 2009

2.3.3 PPP Education

The education sector is a particular case because, first, it is primarily a non-market service with the majority of pupils and students in participating countries receiving their education at prices that are not economically significant from non-market producers and, second, educational services are not homogenous because the organised communication of knowledge will vary with the level and type of education. Due to the particularities of the education sector Eurostat introduced a new methodology in 2008 to calculate PPP[11].

The idea is that without economically-significant prices to value output, the expenditure on education provided by non-market producers cannot be derived as it is for market producers by summing their sales as in previous cases. The alternative way to calculate PPP measures the volume of output directly, rather than basing the PPPs on prices of inputs (such as teacher's salaries). The output method approach that Eurostat and the OECD employ for education makes no distinction between market and non-market producers. The individual consumption expenditures on education by households, by non-profit making institutions serving households and by general government – each of which is a separate basic heading in the Eurostat-OECD classification of GDP expenditures as explained above - are added together to obtain actual individual consumption of education (AICE). PPPs and volume measures are calculated for AICE as a whole. Volume measures for the component individual consumption expenditures are subsequently derived with the overall PPPs for AICE. The approach reflects that

[11] Chapter 8 of the OECD-Eurostat (2012) Manual particularly refers to education and the new methodology applied.

education is an individual service that is consumed by individual and identifiable households. Following the same logit as in the case of PPP in AIC, it is fully consistent with the objective to provide a measure of material well-being that compares what households in participating countries actually consume rather than what they purchase.

To solve the shortcoming about homogeneity across countries, a natural first differentiation is therefore by levels of education and these are captured by the International Standard Classification of Education (ISCED levels). The explanation to do this is that different types of education require typically different types of teaching services. However, differentiation may not be enough on its own within public services for several broad reasons (ONS, 2016): a) generally, differentiation will be carried out by cost of activity whereas it is really more important to capture the attributable contribution to the outcome; b) in practice, it is unlikely to be possible to differentiate so as to obtain wholly homogeneous groups, c) the weightings also should ideally be value weights reflecting the relative values to consumers, for example to describe the proportional contribution of the service categories to the outcomes; and d) all the different quality dimensions cannot be considered through differentiation alone.

Then, when the implicit control for quality change via stratification is insufficient, the final output measure may require an explicit quality adjustment, taking account of the attributable incremental contribution of the service to the outcome[12] (corresponding to the third method to capture quality is the directive from Atkinson (2005)). Explicit adjustments require identification of quality characteristics that are not present in the stratification process and the calculation of an adjustment factor that is applied to unadjusted measures of teaching services. Such adjustments could for example reflect exam scores (O'Mahony and Stevens 2003). Exam scores are the joint outcome of teaching, student effort, natural ability and the broader socio-economic environment.

In the context of measuring education output, it is useful to refine the broad distinction between outputs and outcomes in two ways (Schreyer, 2010). First, outputs are broken down into two components: activities or processes and the quality adjustment applied to them. Processes are observable actions by which education services are delivered although their characteristics may change over time. For education, a typical process measure is the number of pupils or the number of pupil hours taught in a particular grade. Second, outcomes can be broken down into direct and indirect outcomes, the distinction being that direct outcomes are closer to the act of service provision than indirect outcomes although neither direct nor indirect outcomes are measures of services. For example, in the case of education, a direct outcome is the state of knowledge of a population of pupils, estimated by scores or degrees. The indirect outcomes associated with education are employment possibilities and enhanced real earnings due to better education, or GDP growth as a consequence of enhanced human capital. Using the definition of learning by UNESCO and consider learning as an outcome, and the organised communication of knowledge as the relevant output measure, the organised communication of knowledge constitutes the service provided. Figure 2 summarizes the relationship among inputs, outputs.

The Eurostat handbook[13] defines education output as 'the quantity of teaching received by the students, adjusted to allow for the qualities of the services provided for each type of education' (Eurostat-OECD, 2012). That is the reason why a measure of output has to take into account a) the quantity of teaching provided by the producers of education and b) the quality of the education provided by their producers as well as the level and field

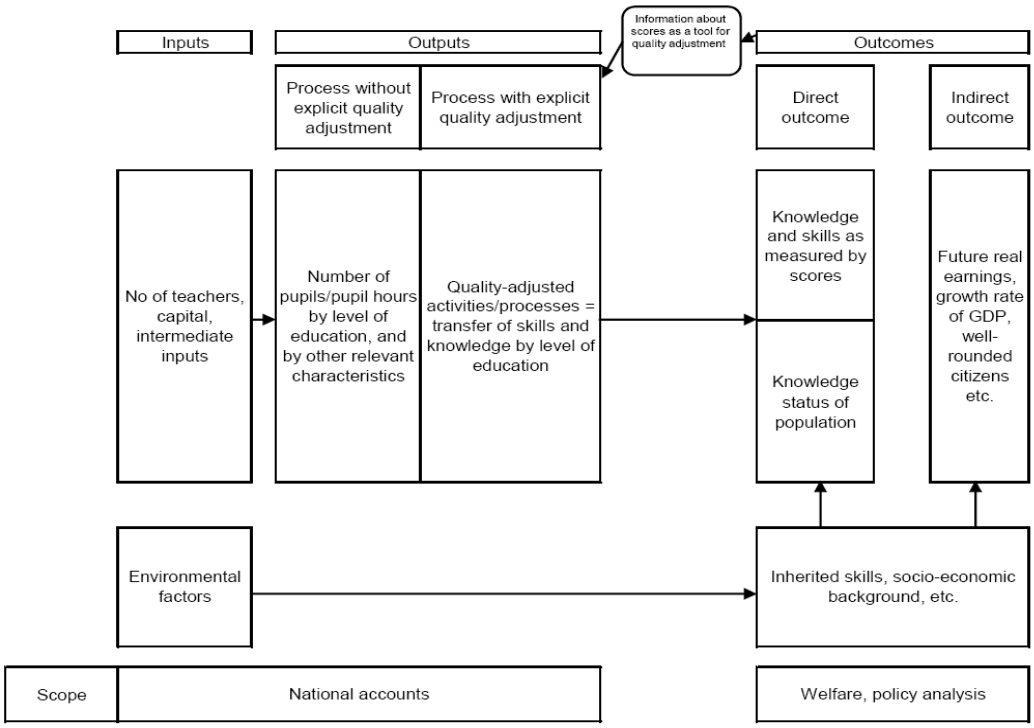
[12] Among national accountants, "outcome" is typically used to describe a state that consumers value. Eurostat (2001) gives as examples of "outcome indicators" the level of education of the population, life expectancy, or the level of crime. Atkinson (2005) has the same usage of the word. Understood in this sense, outcome in itself cannot be a useful way to measure output or the effectiveness of the health or education system.

[13] http://ec.europa.eu/eurostat/documents/3859598/7152852/KS-GQ-14-005-EN-N.pdf/839297d1-3456-487b-8788-24e47b7d98b2

of education. As a measure of quantity of teaching, PPP Education uses the number of students in FTE. As a proxy for quality, PPP education includes information from the PISA survey, specifically economic, social and cultural status (ESCS) corrected PISA scores. PISA results, as an outcome indicator measuring students' levels of attainment in mathematics, reading and science, are considered the most appropriate way of adjusting for the quality of the output according to the Eurostat handbook. However as the PISA survey captures the performance of 15-year-old students, the quality adjustment is only applied for ISCED1 and ISCED2 levels. The final PPPs for AICE are calculated on the basis of quality-adjusted expenditure per student at each ISCED level as unit prices and total expenditure for each ISCED level as weights[14].

The calculation of the quality adjustment scores is a key part of the final PPP weights. For the Eurostat-OECD output method, the PISA ESCS scores are transformed into quality adjustment factor by normalizing them to the average for the EU28 set to 100. The calculation uses information from ESCS scores for mathematics, science and reading for different PISA waves (taking into account that in a PISA study ESCS corrections are only established for one of the three subjects surveyed). Imputations techniques are applied by assuming that the ESCS scores for the missing subjects retain the same relationship with the original scores as they had when ESCS scores were established for them. There is a difference between how Eurostat and OECD calculate the quality adjustment factors. While OECD uses a simpler approach by employing only the latest PISA results, Eurostat takes into account the different waves of PISA survey to weight the three subjects surveyed (mathematics, science and reading)[15].

Figure 2. Inputs, outputs and outcomes in education



Source: Schreyer (2010)

[14] Detailed information about the derivation of the expenditure weights and unit prices is illustrated in Annex I.

[15] Detailed information about the quality adjustment procedure used by Eurostat appears in Eurostat-OECD Methodological Manual on PPPs (Eurostat-OECD, 2012).

3 Comparison of education expenditures across European countries

This section focuses on the empirical comparison of education expenditures when the three different deflators are applied (that is PPP in GDP, PPP in AIC and PPP Education) between 2006 and 2014. This comparison is applied for total general government education expenditures (Section 3.2) but also distinguishing between different COFOG[16] divisions (Section 3.3) and ISCED levels (Section 3.4).

3.1 Data description

Empirical analyses are based on the data from the General Government of Finance and Statistics classified by COFOG and the Education and Training statistics from Unesco-OECD-Eurostat data collection (UOE), both available from Eurostat.

First, general government expenditure by function (COFOG) [gov_10a_exp] includes total general government expenditure in national currency following the national accounts classification and the Education sector using COFOG classification. General expenditure breakdowns by COFOG levels are also analysed. Specifically, the following COFOG categories are used here: a) Current expenditure defined as final consumption expenditure; b) compensation of employees (mainly teacher salaries, in formal and non-formal education); and c) capital expenditure classified as the category gross capital formation (mainly investments, for example school buildings, computers, books tables/chairs/forniture, etc. with an investment timeframe of more than one year).

Second, in order to calculate government education expenditures per capita, information from students in full-time-equivalent (FTE) is used. Due to the break in the time series, information from two different variables is included: a) Students by ISCED level taking into account study intensity [educ_enrl1ad] for the period 2006-2012 and pupils and students enrolled by education level and intensity of participation [educ_uoe_enra01] for the most recent information (2013-2014). In order to calculate expenditure on education by ISCED levels, breakdowns between primary, secondary and tertiary education are applied. Nonetheless, differences in the breakdowns of education expenditures exist between the COFOG and UOE data and should be taken into account. COFOG differentiates between secondary (ISCED 2-3) and post-secondary non-tertiary (ISCED 4) education while these two categories are gather under 'secondary' in UOE data[17]. This report follows the COFOG distinction in the levels of education and groups them for the number of students following Table 2[18].

Table 2. Differences in the disaggregation of education expenditures UOE vs. COFOG

Type of Expenditure by function	UOE	COFOG	In this report
Pre-primary	Residual category	ISCED 0 and 1	Primary education
Primary	ISCED 1		
Secondary	ISCED 2 to 3	ISCED 2 to 4	Secondary education
Post-secondary	ISCED 4		
Tertiary	ISCED 5 and 6	ISCED 5 and 6	Tertiary education

Note: For the more recent period, ISCED7 and ISCED8 is part of Tertiary education.
Source: Adapted from Vera-Toscano (2013).

[16] COFOG is the acronym for Classification of the Functions of Government, which is one of the four classifications of expenditure used in the System of National Accounts (SNA).
[17] Additional categories appear within the ISCED headings but are not taken into account in this report.
[18] For a more detailed discussion about the difference between UOE and COFOG see Vera-Toscano (2013).

Third, deflators are downloaded from Eurostat using PPP information [prc_ppp_ind] using the following national accounts aggregates: a) GDP (Code 00); b) AIC (Code A01); and c) Education (Code A0110). Additionally, an especial extraction from Eurostat has provided the values for PPP Education without quality adjustment measures.

3.2 Total expenditure on education at all ISCED levels

This section focuses on total public expenditure on education across EU countries at all ISCED levels. Education expenditures measured in units of national currency is a primary source of information and a crude measure of expenditure (first column Table 3). This should be the best choice when dealing with data from a country. However, as explained in section 2.1 if the data cover more than a country and need to be compared, it needs to be converted to a common currency – the natural choice for data on EU Member States is the Euro (EUR). Although conversion of national currencies into EUR still implies some comparison problems because the basket of good a services that you can buy in a country with a specific amount of money is not exactly the same as what you can buy in other country.

Columns II, III and IV of Table 3 include also cross-country comparisons of total education expenditures per student at all ISCED levels using the different PPP deflators between 2006 and 2014. On average, EU28 expended almost 6 thousands EUR in 2006 and 6.5 thousands EUR in 2014 in education per student. However, some differences emerge when the different EU MS are compared. Upper income[19] EU countries like Sweden, Austria, Denmark, Netherlands, Belgium or Luxemburg expend in education more than the EU average with figures moving between 7 thousands EUR per student in Austria or Netherlands in 2006 to more than 21 thousands in Luxemburg in 2014 when PPP in GDP is used. Similar figures are obtained when PPP-AIC is applied. On the other hand, lower income EU countries like Romania, Bulgaria, Croatia or Slovakia are those expending lower in education in comparison to their EU counterparts. Their expenditure do not arrive to 4 thousands EUR in any of the analysed years, whatever PPP in GDP or PPP in AIC is taken into account. A different picture of the EU expenditure distribution appears when PPP Education is applied. In this case, the deflator tends to standardize the values of education expenditures of the EU countries with the EU28 average. This means that low income EU countries present higher values of education expenditures (moving between 4 and 5 thousands EUR per student) while in high income EU countries the value of expenditure is lower (between 5 and 8 thousands per student).

After the presentation of absolute figures, Figure 3 reflects the relative position of the EU countries in the expenditure distribution compared to EU28 average (EU28=100). In comparison to the relative position of countries in Figure 3 (order by expenditure on PPP in GDP), slightly differences appear if countries are ordered by expenditure on PPS in AIC. For example, Spain moves from being the 8th to the 5th country with the lowest expenditure on education (35% less than EU28) when PPS in AIC is the convertor unit used. Similarly, Finland expends more than UK when this deflator (PPP in AIC) is applied (3.6% more than EU28). Other countries like Italy and Cyprus or Austria and Denmark only swap their positions within the distribution. The case of Germany is particularly interesting. Although very close to the EU28 expenditure, this country moves from being below the EU average (99.3 percentage points) in terms of purchasing while is above the average (102.1 percentage points) in terms of consumption. In Luxemburg the application of one or other deflator makes a difference. The main reason for this change between PPP in GDP and PPP in AIC relates to the fact that foreign workers contribute to GDP in Luxemburg when they are not resident (and in consequence their purchases are taken into account for the calculus of PPP in GDP), however in terms of consumption the consumption expenditure is registered in national accounts of the country of residence.

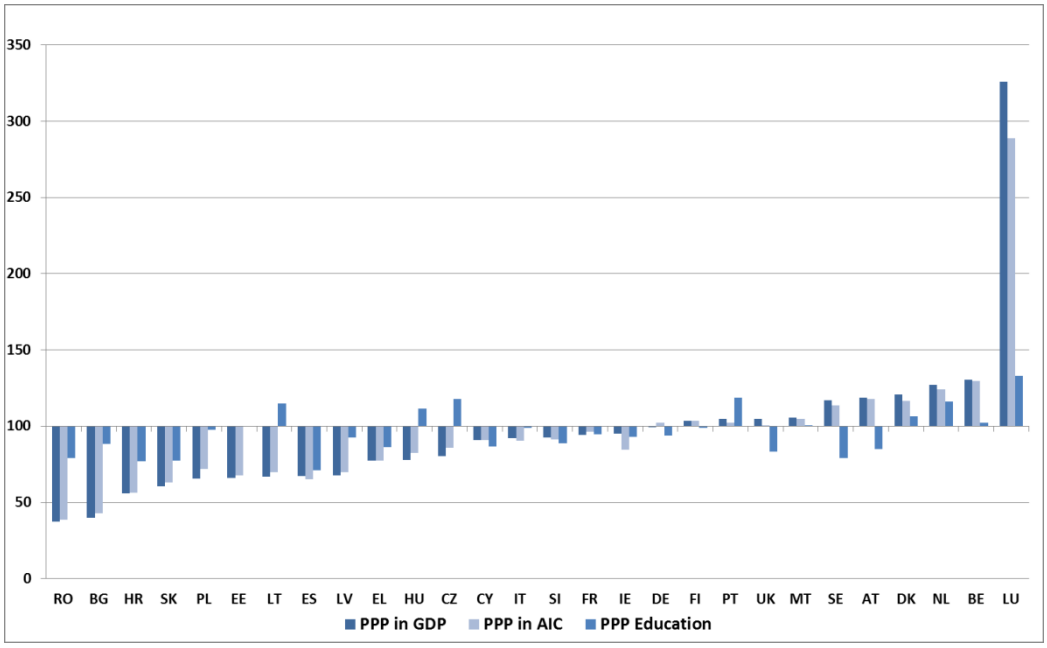
[19] More information about the distinction between lower income and upper income EU countries is available here: http://ec.europa.eu/eurostat/statistics-explained/index.php/GDP_per_capita,_consumption_per_capita_and_price_level_indices

Table 3. Total expenditure on education per student at all ISCED levels.
EU countries order by expenditure on PPP-GDP 2014

COUNTRY	Current prices in national currency		PPP in GDP		PPP in AIC		PPP Education	
	2006	2014	2006	2014	2006	2014	2006	2014
Romania	3,271.25	5,329.95	1,857.14	2,409.59	1,834.26	2,499.51	4,473.22	5,108.20
Bulgaria	1,434.57	2,321.39	1,922.77	2,568.10	1,859.53	2,765.28	4,509.39	5,702.62
Croatia	17,892.36	17,405.16	3,735.37	3,616.04	3,614.45	3,642.52	5,071.03	4,963.09
Slovakia	1,756.99	2,580.27	2,576.13	3,900.27	2,656.15	4,070.47	5,105.89	4,986.39
Poland	7,232.09	10,187.04	3,191.86	4,234.14	3,273.83	4,625.97	5,747.74	6,305.66
Estonia	2,522.56	3,092.80	3,946.80	4,264.53	4,038.13	4,360.41	6,905.76	6,440.19
Lithuania	1,587.99	2,593.49	2,936.29	4,299.04	3,077.71	4,503.73	5,876.12	7,395.68
Spain	4,661.12	3,877.32	5,156.96	4,331.08	5,120.67	4,190.73	4,615.70	4,572.60
Latvia	1,929.44	2,949.14	3,388.23	4,369.24	3,518.53	4,491.45	5,760.53	5,976.45
Greece	3,635.08	4,090.59	4,231.44	5,003.29	4,121.26	5,003.25	3,168.63	5,562.56
Hungary	671,902.44	875,261.74	4,256.08	5,004.36	4,484.10	5,327.44	6,161.36	7,185.58
Czech Republic	81,023.37	90,407.22	4,697.91	5,182.47	4,985.75	5,525.61	6,277.13	7,611.12
Cyprus	5,583.83	5,325.81	6,402.15	5,846.58	6,215.65	5,870.73	4,848.34	5,578.28
Italy	6,214.21	5,977.96	6,068.68	5,941.89	5,863.40	5,821.64	5,277.10	6,363.28
Slovenia	5,015.38	4,782.30	6,716.16	5,980.35	6,627.48	5,893.75	6,192.23	5,730.34
France	6,769.29	6,676.34	6,103.19	6,066.97	6,173.65	6,221.43	5,791.21	6,099.06
Ireland	8,372.15	6,823.58	6,923.48	6,123.37	6,594.53	5,454.54	5,632.12	5,995.75
Germany	5,728.28	6,675.95	5,567.22	6,401.34	5,602.34	6,588.07	5,659.35	6,045.20
EU28	**5,796.65**	**6,448.54**	**5,796.65**	**6,448.54**	**5,796.65**	**6,448.54**	**5,796.65**	**6,448.54**
Finland	7,909.59	8,280.30	6,776.73	6,671.20	6,486.46	6,680.95	6,577.46	6,371.57
Portugal	5,336.63	5,255.89	6,563.00	6,745.08	6,353.70	6,594.59	5,880.68	7,639.92
United Kingdom	6,564.43	6,339.56	8,525.31	6,745.59	8,617.26	6,455.41	7,550.93	5,363.92
Malta	3,497.41	5,462.59	5,065.50	6,804.46	4,987.15	6,756.74	6,110.93	6,485.83
Sweden	93,728.10	90,460.39	8,398.27	7,545.47	8,194.38	7,316.38	5,548.27	5,102.43
Austria	7,605.87	8,311.05	7,227.72	7,652.90	7,282.32	7,598.60	5,305.51	5,488.09
Denmark	94,641.05	78,304.91	9,251.14	7,785.96	8,856.96	7,525.05	6,684.26	6,876.69
Netherlands	8,335.34	8,986.94	7,814.73	8,199.16	7,951.98	8,018.39	6,599.01	7,496.48
Belgium	7,165.24	9,276.59	6,604.58	8,404.91	6,504.69	8,350.97	5,211.16	6,584.51
Luxembourg	17,288.46	25,197.34	15,388.31	21,003.38	14,345.60	18,639.01	7,027.43	8,580.80

Note: In EU28 and The Netherlands information in 2014 are based on 2012 due to the lack of data.
Source: Eurostat tables gov_10a_exp, educ_uoe_enra01 (2006) and educ_enrl1ad (2014) and prc_ppp_ind. See Annex II for information about students included in each country.

Figure 3. Total expenditure on education per student compared to EU average in 2014 (EU28=100).
EU countries order by expenditure on PPP-GDP



Source: Eurostat tables gov_10a_exp and educ_enrl1ad and prc_ppp_ind.

The application of PPP Education as deflator does not only change the position of EU countries in the expenditure distribution, also their relative position in comparison to EU average is different. In 2014, Lithuania, Hungary and Czech Republic are below EU28 education expenditures in terms of purchases and consumption while they locate at the right-end of the expenditure distribution when PPP Education is applied (with values in PPP Education between 111 in the case of Hungary and 118 in the case of Czech Republic), only advanced by Netherlands, Portugal and Luxemburg (with PPP Education values 116, 118 and 133 respectively). On the opposite side, Germany, Finland, United Kingdom, Sweden and Austria are top countries on education expenditures traditionally, while they locate below the EU average after the application of PPP Education. With the exception of Slovakia, Spain and Austria, the rest of the EU countries with the lowest expenditure in educations when PPP Education is applied are non-euro countries (Croatia, Sweden, Romania and United Kingdom).

The recommended option to compare expenditure in time and in space proposed by the IEG Indicator Expert Group on Education Expenditure is based on a ratio (or share) index where the numerator is the education expenditures and, as denominator, alternatively could be used the GDP or the total general government expenditures. However, for the particularities of this report comparing deflators to apply, there is no difference between the type of convertor unit used because a share is a relative measure where numerator and denominator should be expressed in the same standardized units (whatever the option chosen is).

3.3 Expenditure on education by COFOG level

The table below (Table 4) shows the distribution of education expenditures by function using government finance statistics as source (COFOG). The table provides the most basic distinction between current expenditure, compensation of employees (mainly teacher salaries, in formal and non-formal education) and capital expenditure. Additionally, Annex III provides a complementary table comparing the expenditure on education of each MS with EU28.

Similar patterns to those found for total expenditure appear when different COFOG levels are analysed. The relative position of EU MS in current expenditure, compensation of

employees and capital expenditure distributions are quite similar when PPP in GDP or PPP in AIC are applied, however the picture changes when PPP Education is used.

EU28 expended on average more than 5 thousands EUR per student in current expenditure in 2014, which means 87.8% of the total public expenditure on education. Additionally to the position of MS across the distributions, countries like Lithuania, Poland, Hungary or Czech Republic are below the EU average in current expenditure when PPP in GDP or PPP in AIC is applied, while they reflect higher values when PPP Education is used. In particular, for these countries the value of expenditure in current expenditure applying PPP in GDP or PPP in AIC locates up to 3 thousands EUR while with the deflator PPP Education moves up to 5 thousands EUR. On the contrary, Denmark, Sweden and Austria decrease positions following the EU28 average. In this case, while the current expenditure using PPP in GDP or PPP in AIC moves between the 5 thousands in Denmark and the 7 thousands EUR of Austria, the expenditure decreases when PPP Education is applied (with values close to or lower than 5 thousands EUR).

In the case of compensation of employees, the expenditure covering the highest part of education expenditures, EU28 expended on average in 2014 almost 3.9 thousands EUR per student, which represents 67% of total education expenditures. Like in previous cases, differences are evident when different deflators are applied. For example, Lithuania moves from being the 9th country with the lowest expenditure on compensation of employees when PPP in GDP is applied (2.7 thousands EUR), to be located within the top 5 with the highest expenditure when PPP Education is the deflator used (4.7 thousands of EUR). An important change also appears in the case of Sweden, being a country located in the middle part of the expenditure in the compensation of employees distribution (3.4 thousands of EUR) when both PPP in GDP and PPP in AIC are applied, to be the EU MS where the human capital costs of these employees are the cheapest (2.3 thousands of EUR) when PPP Education is taken into account.

For capital expenditure, EU28 expended less than 500 EUR on average, with figures that move between 3.3 thousands EUR in the case of Luxemburg until 148 EUR in the case of Slovakia for PPP in GDP. Bulgaria or Estonia are below the EU average in terms of purchases and consumption (more than 400 EUR), while they expend more than EU28 when PPP Education is applied (almost double of previous amount). Germany and Belgium are in the opposite case, while these countries expended less than the EU28 average when PPP in GDP or PPP in AIC are applied (more than 500 EUR) they locate below the average of the MS when PPP Education is taken into account.

3.4 Expenditure on education by ISCED level

This section focuses on the comparison of education expenditures at different ISCED levels (that is primary, secondary and tertiary education). As mentioned in section 3.1 and in agreement with CRELL approach (see Vera-Toscano, 2013), expenditure in education by ISCED levels is treated as follow: a) Primary education includes total expenditure in pre-primary and primary divided by students FTE in ISCED0 and ISCED1; b) Secondary education includes total expenditure in secondary and post-secondary education divided by students FTE in ISCED2, ISCED3 and ISCED4; and c) Tertiary education includes total expenditure in tertiary education divided by students FTE in ISCED5, ISCED6, ISCED7 and ISCED8.

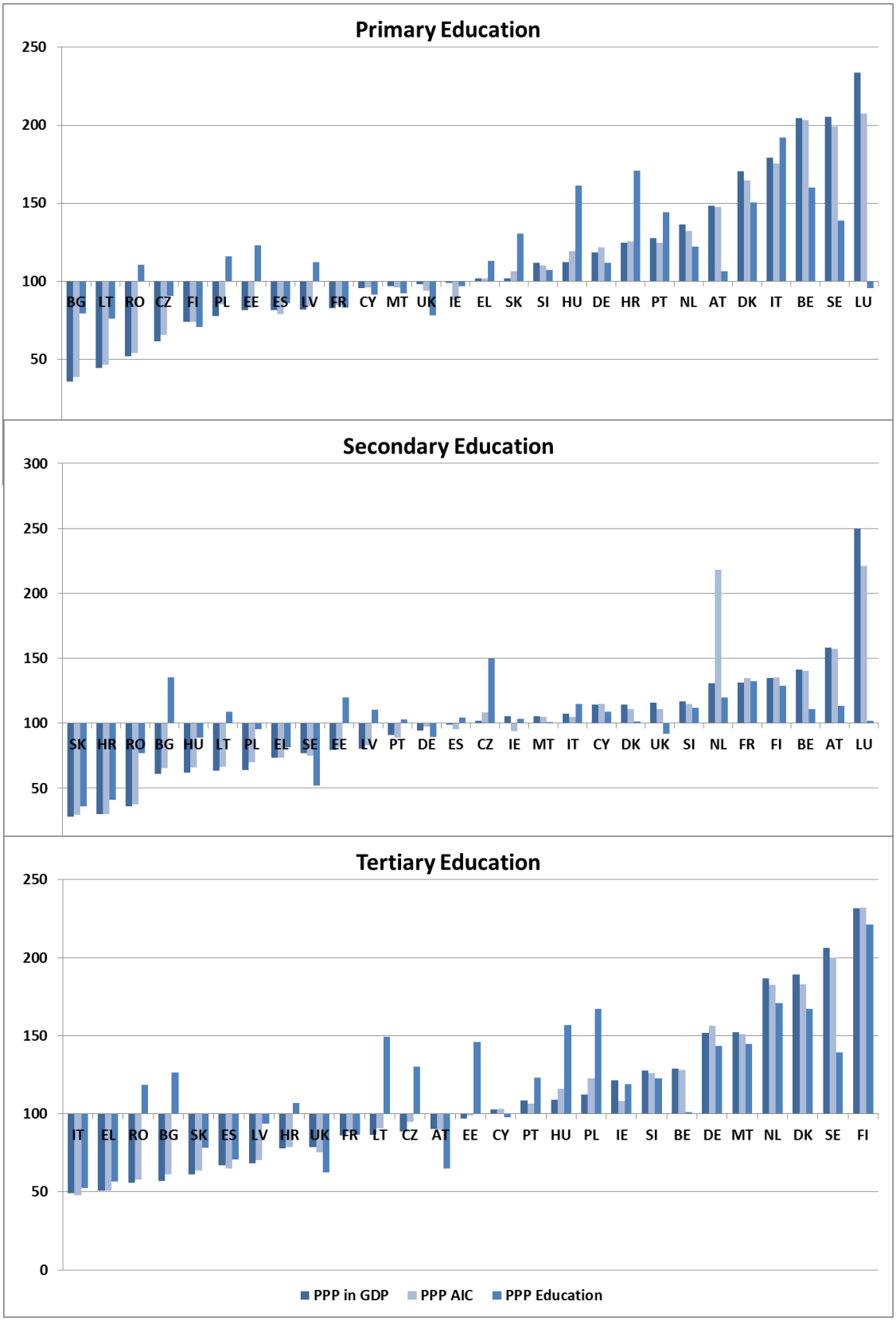
Figure 4 includes the expenditure on education of EU MS compared to EU28 in primary, secondary and tertiary education in 2014. In general, the higher the level of education is, the higher the expenditure per student. On average, EU28 expended 4.7 thousands EUR on primary education, 5.4 thousands EUR on secondary education and 5.7 thousands on tertiary education. In each graph of Figure 4, countries are ordered from the lowest to the highest education expenditures in each ISCED level (Luxemburg is not included in the tertiary education graph because information about students is not fully provided).

Table 4. Eexpenditure on education per student by COFOG level in 2014.

COUNTRY	Current expenditure			Compensation of employees			Capital Expenditure		
	PPP in GDP	PPP in AIC	PPP Education	PPP in GDP	PPP in AIC	PPP Education	PPP in GDP	PPP in AIC	PPP Education
EU28	5,090.24	5,090.24	5,090.24	3,877.92	3,877.92	3,877.92	492.57	492.57	492.57
Belgium	7,856.47	7,806.04	6,154.85	6,641.47	6,598.84	5,203.01	551.78	548.24	432.27
Bulgaria	2,087.49	2,247.77	4,635.40	1,571.76	1,692.45	3,490.20	413.83	445.60	918.93
Czech Republic	3,787.89	4,038.69	5,563.01	2,653.42	2,829.10	3,896.89	1,286.29	1,371.45	1,889.08
Denmark	5,319.93	5,141.66	4,698.66	3,861.69	3,732.29	3,410.71	596.58	576.59	526.91
Germany	5,120.87	5,270.25	4,835.97	3,676.11	3,783.34	3,471.59	500.92	515.53	473.05
Estonia	3,331.97	3,406.89	5,031.87	2,512.11	2,568.59	3,793.73	482.57	493.42	728.76
Ireland	4,607.51	4,104.26	4,511.48	3,751.78	3,341.99	3,673.58	377.69	336.44	369.82
Greece	4,496.63	4,496.60	4,999.27	3,969.53	3,969.51	4,413.25	532.21	532.21	591.70
Spain	4,010.07	3,880.12	4,233.69	2,931.04	2,836.06	3,094.49	136.80	132.37	144.43
France	4,675.55	4,794.58	4,700.28	4,137.30	4,242.63	4,159.19	389.62	399.54	391.69
Croatia	3,241.16	3,264.90	4,448.56	2,690.16	2,709.85	3,692.29	168.55	169.78	231.34
Italy	5,267.21	5,160.62	5,640.75	4,472.62	4,382.11	4,789.81	222.56	218.06	238.35
Cyprus	5,367.82	5,390.00	5,121.49	4,595.16	4,614.14	4,384.28	194.19	194.99	185.27
Latvia	3,290.16	3,382.18	4,500.43	2,406.67	2,473.99	3,291.96	882.86	907.55	1,207.61
Lithuania	3,284.51	3,440.90	5,650.38	2,718.82	2,848.27	4,677.22	674.89	707.02	1,161.02
Luxembourg	15,640.66	13,879.98	6,389.89	13,783.21	12,231.62	5,631.04	3,279.85	2,910.64	1,339.96
Hungary	3,706.75	3,946.07	5,322.40	2,686.58	2,860.03	3,857.57	367.73	391.47	528.02
Malta	5,009.32	4,974.19	4,774.75	4,255.68	4,225.84	4,056.40	559.81	555.88	533.59
Netherlands	6,659.53	6,512.71	6,088.81	4,797.92	4,692.14	4,386.73	746.03	729.58	682.09
Austria	7,020.57	6,970.77	5,034.63	4,899.47	4,864.71	3,513.53	341.06	338.64	244.59
Poland	3,446.51	3,765.46	5,132.69	2,829.86	3,091.74	4,214.35	329.72	360.23	491.03
Portugal	5,239.39	5,122.49	5,934.47	4,419.93	4,321.32	5,006.30	659.92	645.20	747.47
Romania	1,618.00	1,678.38	3,430.07	1,435.03	1,488.57	3,042.17	208.26	216.03	441.50
Slovenia	4,604.29	4,537.62	4,411.80	3,667.79	3,614.67	3,514.45	667.19	657.53	639.30
Slovakia	3,001.45	3,132.44	3,837.28	2,534.24	2,644.83	3,239.96	147.82	154.27	188.99
Finland	4,906.75	4,913.92	4,686.37	3,362.92	3,367.84	3,211.88	757.36	758.47	723.34
Sweden	6,968.77	6,757.18	4,712.45	3,408.26	3,304.78	2,304.74	365.92	354.81	247.44

Note: EU28 and Netherlands values are based on 2012.
Source: Eurostat tables gov_10a_exp, educ_enrl1ad and prc_ppp_ind. See Annex II for information about students included in each country.

Figure 4. Total expenditure on education by ISCED levels compared to EU28 in 2014

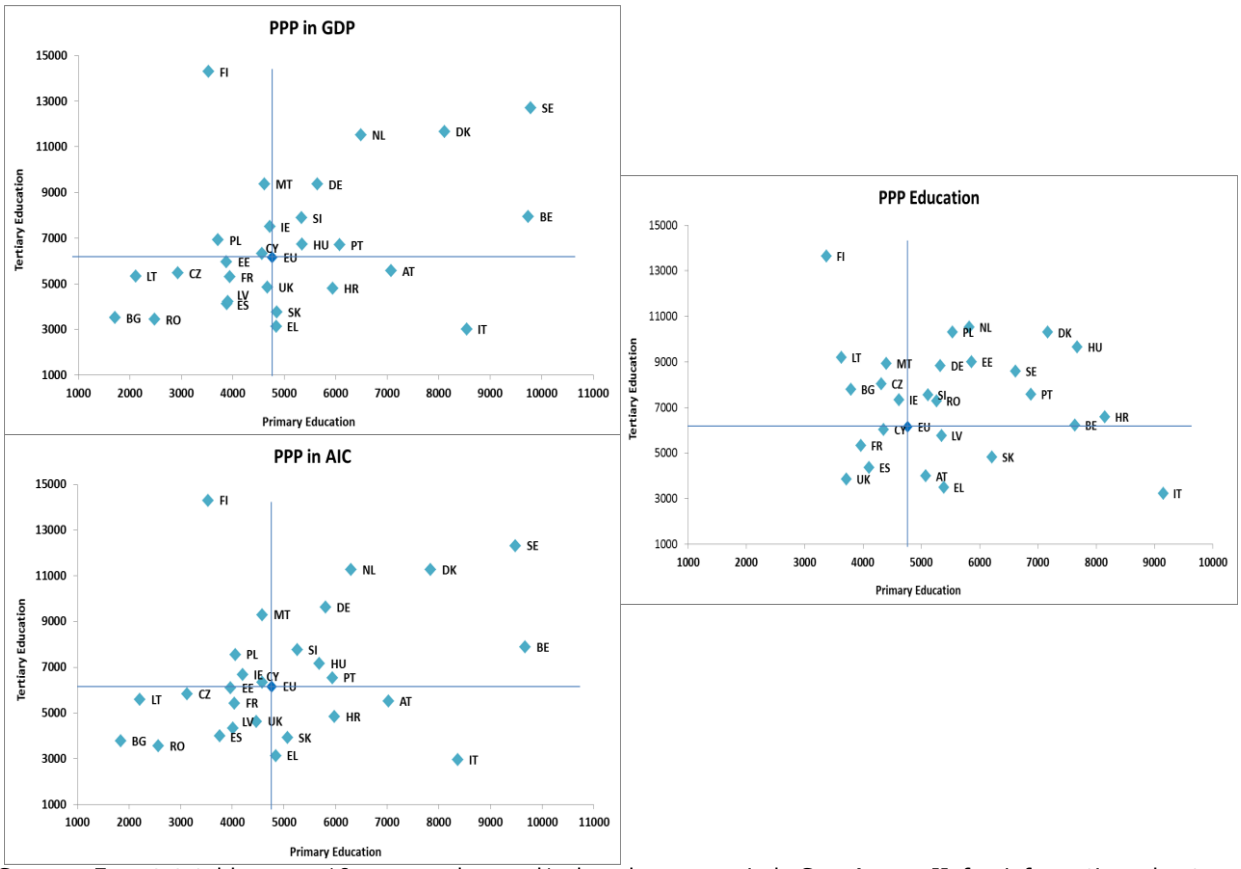


Source: Eurostat tables gov_10a_exp, educ_enrl1ad and prc_ppp_ind. See Annex II for information about students included in each country. Luxemburg is not included in Tertiary education due to the missing data.

In Primary education, Netherlands, Austria, Denmark, Italy, Belgium and Sweden are the countries with the highest expenditure on education at this level when PPP in GDP and PPP in AIC are used. However, Luxemburg is the top country in education purchases and consumption (twice as much EU28 expenditure) while it is below the EU28 average when PPP education is applied. On the other side of the primary expenditure distribution, Bulgaria, Lithuania, Romania, Czech Republic and Finland appear in the graph with the lowest expenditure in this type of education level. Romania, Poland, Estonia and Latvia expend less EUR in primary education than EU28 when PPP in GDP or PPP in AIC is applied, however they are above other EU countries when PPP Education is taken into account.

In secondary education (Figure 4, second graph), Luxemburg, Austria, Belgium, Finland, France and Netherlands are at the top of the expenditure distribution, while Slovakia, Croatia, Romania, Bulgaria, Hungary, Lithuania and Poland are located at the left hand side of the distribution. Ireland is the only country showing changes in its position in comparison to EU average: while households in these countries purchase more secondary education than other EU countries, their consumption is lower than EU28. Bulgaria, Lithuania, Estonia, Latvia, Portugal and Spain are in this case the most affected countries by the application of PPP Education. Germany, Malta, Netherlands, Denmark, Sweden and Finland are the leaders in expenditure in tertiary education regardless the convertor unit applied, expending around 50% more than EU28. Italy and Greece however spend 50% less money than EU28. Like in previous ISCED levels, the application of PPP in Education changes the relative position of countries like Romania, Bulgaria, Hungary, Lithuania, Czech Republic and Estonia.

Figure 5. Total expenditure on education by ISCED level



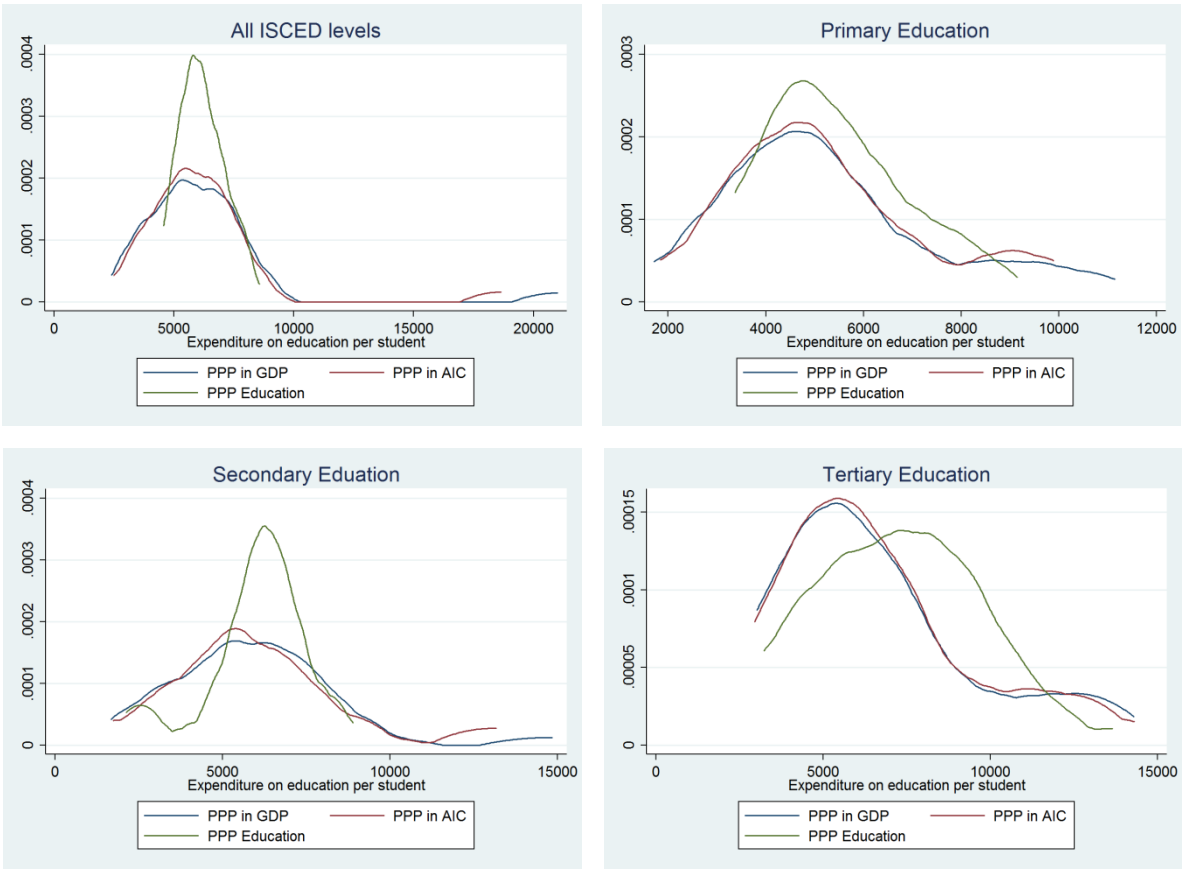
Source: Eurostat tables gov_10a_exp, educ_enrl1ad and prc_ppp_ind. See Annex II for information about students included in each country. Luxemburg is not included in due to the missing data in Tertiary education.

Figure 5 compare the expenditure on tertiary and primary level of education of the EU MS. The application of PPP in GDP or AIC returns the same relative position of EU MS (Figure 5 left graphs), however the scatter plot comparing tertiary and primary education varies when PPP Education is applied (Figure 5 right, graph). Regardless the convertor unit applied, countries like Belgium, Greece, Italy and Austria expend more in primary education than in tertiary studies. However, there are other countries changing their relative position in comparison to EU28 average. Using PPP Education, only Cyprus, France, Spain and United Kingdom expended less than the EU average in both levels of education, primary and tertiary, while using PPP in GDP or PPP in AIC the number of countries located in this bottom-left quadrant is higher (Estonia, Latvia, Czech Republic, Lithuania, Bulgaria and Romania are also part of but United Kingdom is in the bottom-right quadrant –that is, lower levels of tertiary expenditure but higher levels in primary expenditure than EU28 average).

3.5 Comparison among the three converto units applied in PPP

This section provides an analysis of the distribution of the three convertor units studied in this report. The main purpose of this section is to provide empirical evidence to conclude some advantages and disadvantages of the convertor units. To do that, Figure 6 presents the kernel distributions of expenditure on education per student. The kernel density estimation is a non-parametric way to estimate the probability density function of a random variable (expenditure per student in this particular case). The kernel density estimate is an alternative computer-intensive method, which involves smoothing the data while retaining the overall structure (AMCTB, 2006). In this case the graphs compare the distribution of the expenditure on education when the three convertor units are applied at all ISCED levels (Figure 6, top-left graph) and by ISCED levels (primary –Figure 6, top-right-, secondary –Figure 6, bottom-left- and tertiary education –Figure 6, bottom-right-).

Figure 6. Kernel distribution of expenditure on education per student in 2014 by ISCED level



Results suggest the kernel distribution of public education expenditures using PPP in GDP and PPP in AIC are very similar, however the kernel distribution of PPP Education differ from the other two. These results apply to all ISCED levels and to primary, secondary and tertiary levels of education. In general the application of PPP in GDP and PPP in AIC to expenditure on education return a right-skewed distributions, that is, where the majority of the EU countries are located at the left-hand side of the distribution (lower expenders) while a small group of countries are located at the right part (higher expenders). In primary and tertiary education this is also the shape of the expenditure distribution when PPP Education is applied. However, at all ISCED levels and for secondary education the shape of this distribution is standardized, closer to the normal distribution, with less outlier countries and smaller deviation from the EU average.

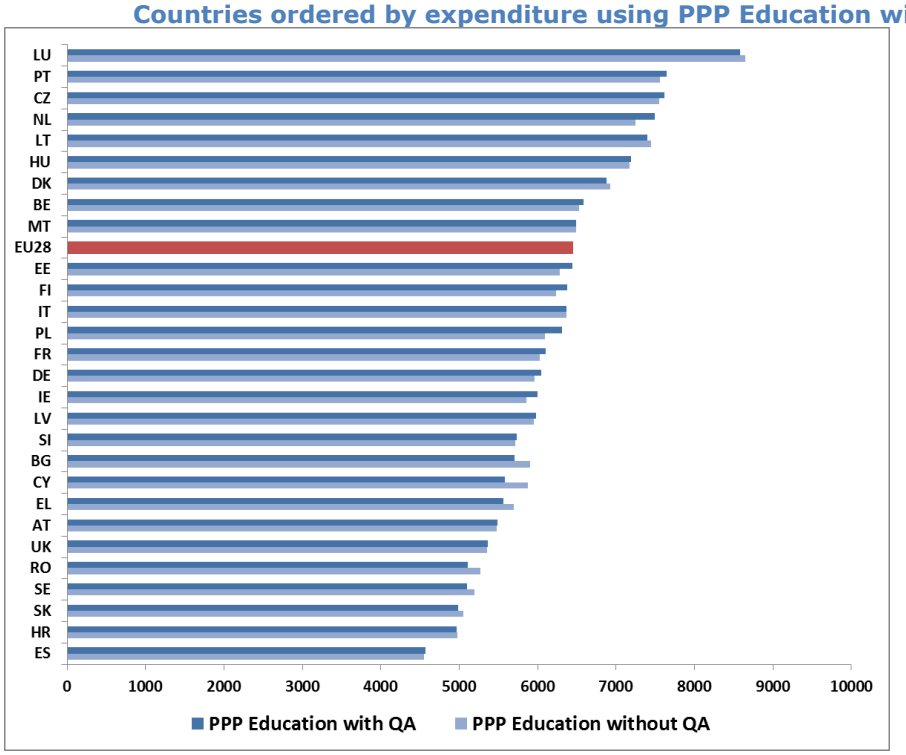
4 Purchasing power parities in education with and without quality adjustment

As mentioned in Section 2.3 PPP education is based on the output method measuring the quantity of teaching provided by the producers of education and combined with a quality-adjustment measure to capture the changes in the quality of the education provided by their producers as well as the state of knowledge of a population of pupils and the level and the field of education for which the education is provided (capturing that different types of education require typically different types of teaching services). Explicit adjustments require identification of quality characteristics that are not present in the stratification process and the calculation of an adjustment factor that is applied to unadjusted measures of teaching services.

The calculation of PPP Education is currently adjusted using PISA scores because it is considered as a measure of the level of skills and knowledge of 15 year-old students. The theoretical argument behind this is that, although an imperfect measure of quality, once PISA scores are corrected or adjusted by the impact of family and social environment, the output measure is only reflecting the skills and knowledge transferred by the school system through formal education. The objective of this section is to provide empirical evidence about the difference in the application of the PPP Education as a convertor when PISA scores are including as a qualitative-adjustment (QA) measure and without this weight. The comparisons are done for public expenditure on education at all ISCED levels in 2014.

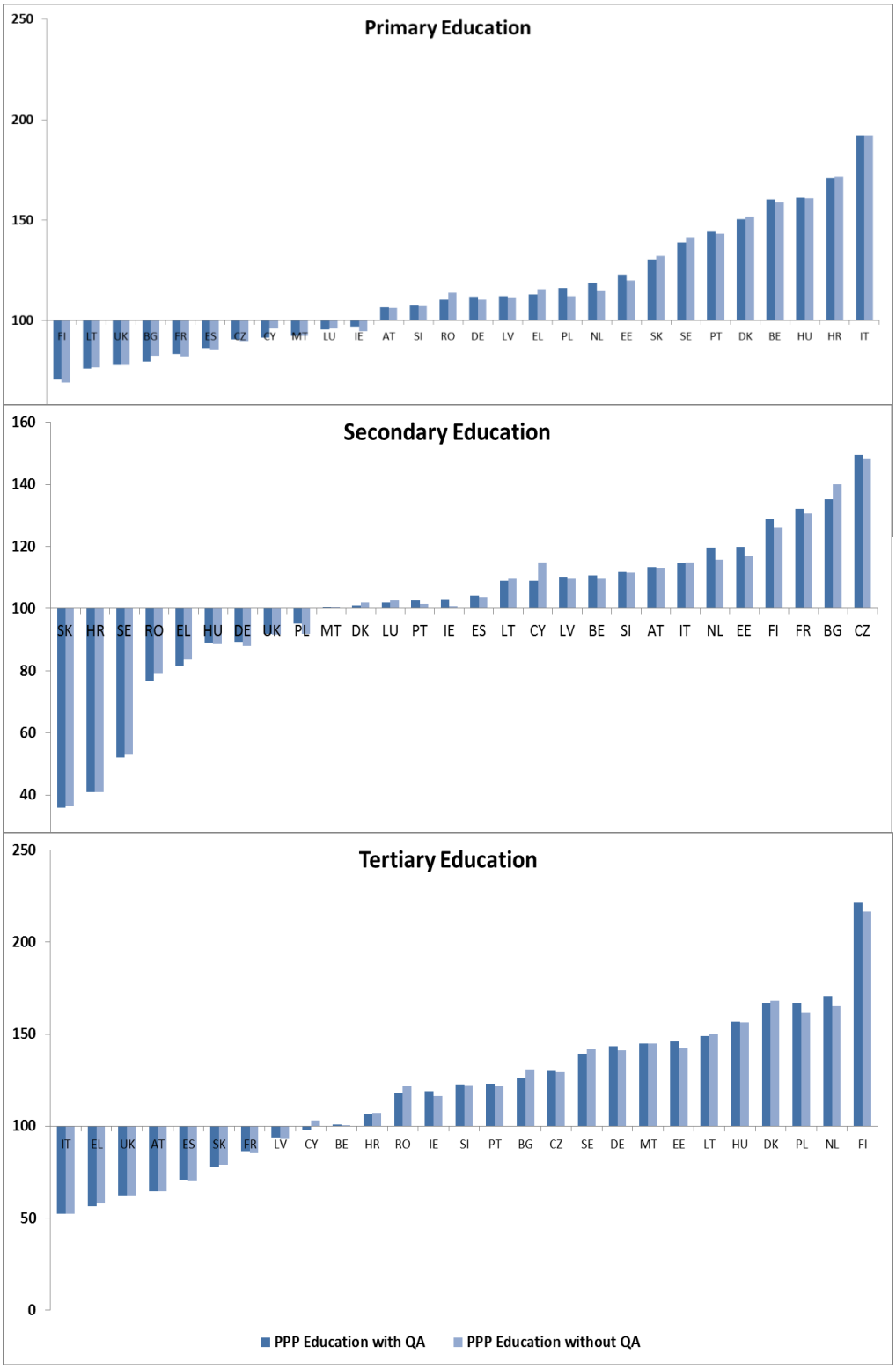
Figure 7 presents expenditure on education per student when PPP Education with and without QA are applied. The relative position of MS across the expenditure distribution is very similar when the QA is or is not taken into account. There are only few changes between a) Cyprus, Bulgaria, Slovenia, Latvia and Ireland, b) Italy, Finland and Estonia as well as c) Lithuania and Netherlands exchanging their positions.

Figure 7. Expenditure on education per student in PPP Education with and without QA. Countries ordered by expenditure using PPP Education with QA.



Note: Netherlands includes expenditure on education with PPP Education with QA in 2012 while without QA refers to 2014.

Figure 8. Expenditure on education per student in PPP Education with and without QA by ISCED level.
Countries ordered by expenditure at each level using PPP Education with QA.



Source: Eurostat tables gov_10a_exp, educ_enrl1ad and prc_ppp_ind. See Annex II for information about students included in each country. LU not included in Tertiary education due to the missing data. Special extraction from Eurostat to calculate PPP without QA.

Figure 8 (and Annex IV) provides similar information for the comparison of expenditure when PPP Education with and without QA are applied by ISCED levels. Similar to previous results at all ISCED levels both distributions follow very similar pattern, there

are only small exchanges in positions across the EU MS. The higher the level of education is, the more countries exchange their positions in the expenditure distribution. In Primary education, Cyprus, Malta and Ireland permute themselves as well as Romania, Germany, Latvia, Greece, Portugal and Netherlands. At secondary level, Hungary and Germany, Denmark, Luxemburg, Portugal and Ireland as well as Cyprus, Belgium, Austria, Slovenia and Italy move also up or down until a maximum of 2 positions in comparison to their current place. In tertiary education, with the exception of MS located at the left-hand side of the distribution (from Italy to Latvia) as well as Croatia, Lithuania, Hungary, Finland and Luxemburg, the rest of the countries slightly exchange their positions although without notable changes.

5 Conclusion

The starting point of this brief has been the use of purchasing power parities (PPP) as a deflator to convert different currencies to a common currency and, in the process of conversion, to equalize their purchasing power by eliminating the differences in price levels between countries. This convertor unit is particularly useful for the comparison of expenditures across EU MS. In particular, this brief has focused on education, a primarily non-market service with the majority of students receiving education at prices that are not economically significant from non-market procedures. This means that education, as other non-market services, is considered to be comparison resistant because a) there are no economically-significant prices with which to value output and b) units of output are difficult to define and measure due to the differences in the quality output between countries. In order to solve these limitations, different methods to calculate PPP have been applied. The main objective of this report has been then the comparison of three different deflators to apply to public education expenditures in order to become comparable across EU MS. The convertors units selected are: a) PPP in GDP (purchases), the traditional deflator; b) PPP in AIC (consumption) as an alternative weight based on real consumption instead of purchases; and c) PPP Education as particular consumption only including education outputs.

According to the three objectives of this briefing, the conclusions can be structured following the same pattern. First, from a methodological perspective, the briefing has compared the basket elements of goods and services included in the construction of PPP. PPP in GDP follows the same basket elements of goods and services as the ones for the measurement of countries GDP. Starting from the specific PPPs calculated for individual goods and services, they are also computed for product groups and for each of the various levels of aggregation up to and including the whole GDP basket. On the other hand, PPP in AIC includes a more restrictive definition. In this case, AIC is calculated as household consumption expenditure plus "individual consumption," which is the amount spent by general government and the NPISHs on things that directly benefit households (that is households do not pay directly for these services but they benefit from them). PPP Education is an alternative procedure based on education outputs real consumption (AICE) rather than basing the PPPs on prices of inputs (such as teacher's salaries). AICE takes into account both the quantity and quality of teaching provided by the producers of education and the calculations are based on number of students in FTE (as a measure of quantity) and ESCS PISA scores (as a proxy for quality). The inclusion of a quality measure is not so straightforward, however it can be considered as an approximation to control for the different qualities of education outputs across countries in order to be comparable. The quality adjustment is understood as the direct outcome is the state of knowledge of a population of pupils estimated by scores obtained. The application of this particular quality scores are in line with the Eurostat handbook recommending the use of outcomes to adjust for quality.

Second, from an empirical point of view, the briefing has compared education expenditures per student in PPS across MS at different levels. On average, EU28 expended almost 6 thousands EUR in 2006 and 6.5 thousands EUR in 2014 in education per student. However, some differences emerge when the different EU MS are compared and when the different deflators are taken into account. In particular, the expenditure on education distribution is very similar when both PPP in GDP and PPP in AIC are applied, but substantially differs when PPP Education is the deflator selected. The main explanation relates to the differences in the basket elements of the three deflators used according to previous paragraph. The elements included in the basket of PPP in AIC are closer to the ones part of PPP in GDP, because the first focus on consumption while the second focus on purchasing. This finding is in line with previous policy recommendation from other international organizations suggesting that "GDP per capital provides an average measure of economic activity but for comparisons of material well-being of households, actual individual consumption per capita is preferred" (OECD, 2013). This applies particularly for non-market services, like education, when the delivery of these

services to households differs across countries. This empirical evidence also applies when PPP is calculated at different COFOG and ISCED levels. That is, like at general level similar trends in education expenditures appear when PPP in GDP or PPP in AIC are applied, but a significantly different picture is evident when PPP Education is taken into account. These important differences suggest that additional investigations are needed in the case of PPP Education, particularly in the case of the quality adjustment measures because secondary and tertiary education are not weighted.

Third, last section of the report focuses on the assessment of the quality adjustment factor included in the PPP Education deflator based on PISA scores. According to the results presented here, the application or not application of PISA scores as a quality adjustment measure does not make any substantial difference on the education expenditures distribution of MS. Or in other words, the relative position of European countries scarcely changes when the quality-adjustment measure is included to calculate the convertor unit. This result reinforce the adequacy of the use of quality adjustment proxies on the output method to guarantee a better comparability across countries as mentioned in the conclusion of the first objective of this brief.

In sum, three main conclusions and policy recommendations can be extracted from this exercise:

1) The selection of the deflator matters when purchasing power parities are used in international expenditure comparison.

2) While PPP in GDP is the traditional deflator used, PPP in AIC provides a better measure of economic activity for comparisons of material well-being of household. However the application of PPP Education significantly changes the expenditure distribution picture of EU MS.

3) The inclusion or exclusion of the quality-adjustment (measure through PISA scores) to calculate PPP Education does not change the relative position of the EU MS in the expenditure distribution, but it is a recommended approximation to control for the different qualities of education outputs as an outcome of the state of knowledge of a population of pupils estimated by scores obtained.

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Annex

Annex I. Detailed algorithm to calculate PPP Education

The PPPs for AICE are calculated on the basis of quality-adjusted expenditure per student at each ISCED level as unit prices and total expenditure for each ISCED level as weights. Following the Eurostat-OECD (2012) manual, the derivation of the expenditure weights and unit prices is as follow:

ROW		Comments
1.1 ISCED FTE student numbers		
1	ISCED0	UOE database
2	ISCED1	UOE database
3	ISCED2	UOE database
4	ISCED3+4	UOE database
5	ISCED5+6	UOE database
6	Total	UOE database
1.2 Public and private education expenditures by ISCED		
7	ISCED0	UOE database
8	ISCED1	UOE database
9	ISCED2	UOE database
10	ISCED3+4	UOE database
11	ISCED5+6	UOE database
12	Total	UOE database
1.3 Actual individual consumption of education (AICE) in national currency (millions)		
13		NA database
1.4 Population (1000)		
14		Population database
1.5 Exchange rate (national currency per euro)		
15		Exchange rate database
2.1 ISCED FTE student numbers as shares		
16	ISCED0	Row 1 divided by row 6
17	ISCED1	Row 2 divided by row 6
18	ISCED2	Row 3 divided by row 6
19	ISCED3+4	Row 4 divided by row 6
20	ISCED5+6	Row 5 divided by row 6
21	Total	
3.1 FTE students as a percentage of total population		
22		Row 6 divided by row 14
3.2 Preliminary volume index		
23		Row 22 divided by the student percentage of total population for the EU28
3.3 AICE per FTE student in national currency		
24		Row 13 divided by row 6
3.4 ACIE per student in euros		
25		Row 24 divided by row 15
3.5 Preliminary price level index (EU28=100)		
26		Row 25 divided by the EU28 geometric mean for the row
4.1 ISCED expenditure shares		
27	ISCED0	Row 7 divided by row 12
28	ISCED1	Row 8 divided by row 12
29	ISCED2	Row 9 divided by row 12
30	ISCED3+4	Row 10 divided by row 12
31	ISCED5+6	Row 11 divided by row 12
32	Total	
4.2 Adjustment for research expenditure		
33		UOE database and R&D statistics
34	ISCED5+6	Row 31 multiplied by (100 minus row 33)
4.3 ISCED expenditure shares rescaled after adjustment for research expenditures		
35	ISCED0	Row 27 divided by the sum of rows 27, 28, 29, 30, 34
36	ISCED1	Row 28 divided by the sum of rows 27, 28, 29, 30, 34
37	ISCED2	Row 29 divided by the sum of rows 27, 28, 29, 30, 34
38	ISCED3+4	Row 30 divided by the sum of rows 27, 28, 29, 30, 34

39	ISCED5+6	Row 31 divided by the sum of rows 27, 28, 29, 30, 34
40	Total	
4.4 AICE by ISCED in national currency (millions) -used as expenditure weights in the calculation of PPPs		
41	ISCED0	Row 13 multiplied by row 35
42	ISCED1	Row 13 multiplied by row 36
43	ISCED2	Row 13 multiplied by row 37
44	ISCED3+4	Row 13 multiplied by row 38
45	ISCED5+6	Row 13 multiplied by row 39
46	Total	
5.1 AICE per FTE student by ISCED before quality adjustment		
47	ISCED0	Row 41 divided by row 01
48	ISCED1	Row 42 divided by row 02
49	ISCED2	Row 43 divided by row 03
50	ISCED3+4	Row 44 divided by row 04
51	ISCED5+6	Row 45 divided by row 05
5.2 Quality adjustment for ISCED1 and ISCED2		
52	ISCED1	PISA 2009 (row 22 in quality adjustment worksheet)
53	ISCED2	PISA 2009 (row 22 in quality adjustment worksheet)
5.3 AICE per FTE student by ISCED after quality adjustment -used as unit prices in the calculations of PPPs		
54	ISCED0	
55	ISCED1	Row 48 divided by row 52
56	ISCED2	Row 49 divided by row 53
57	ISCED3+4	
58	ISCED5+6	

Source: Adapted from Eurostat-OECD (2012) Manual

PPPs for AICE are calculated with the matrix of unit prices and the matrix of expenditure weights derived above. The matrices, defined as ISCED levels by participating countries, are complete. Final PPPs for AICE are calculated as follows:

1) The matrix of Laspeyres type PPPs between two countries is calculated as the arithmetic mean of the price rations weighted with the weights of the base country from the following equation:

$$L_{j|h} = \frac{\sum_{i=1}^{k} \left(\frac{P_{ij}}{P_{ih}}\right) * w_{ih}}{\sum_{i=1}^{k} w_{ih}}$$

2) These Laspeyres type PPPs are then transformed and their reciprocals taken to erive a matrix of Paasche type PPP as follows:

$$P_{j|h} = \frac{\sum_{i=1}^{k} w_{ij}}{\sum_{i=1}^{m} w_{ij} / \left(\frac{P_{ij}}{P_{ih}}\right)}$$

3) The geometric means of the two sets of PPPs provide a matrix of Fisher type PPPs which are made transitive by the Èltetö-Köves-Szulc (EKS) process. The EKS PPPs are used to convert the national expenditures that participating countries report for AICE to real expenditures. The real expenditures are subsequently expressed as volume indices and per capita volume indices.

Annex II. Notes about students included in each country by year

	ALL ISCED		Primary	Secondary	Tertiary
	2013	2014	2014	2014	2014
Belgium	Not included ISCED0	Not included ISCED0	Only included ISCED1		
Bulgaria					Not included ISCED5
Czech Republic					
Denmark				Not included ISCED4	
Germany					
Estonia					Not included ISCED5
Ireland	Not included ISCED0	Not included ISCED0	Only included ISCED1		
Greece	Not included ISCED3&4	Not included ISCED0&4&5&7	Only included ISCED1	Not included ISCED4	Not included ISCED5&7
Spain					
France	No information				
Croatia				Not included ISCED4	
Italy	Not included ISCED0	Not included ISCED0	Only included ISCED1		
Cyprus					
Latvia					
Lithuania					Not included ISCED5
Luxembourg	Not included ISCED6&7&8	Not included ISCED6&7&8			Only included ISCED5
Hungary	Not included ISCED0	Not included ISCED0	Only included ISCED1		
Malta					
Netherlands	Not calculated because only information for ISCED4&8	Not calculated because only information for ISCED4&8		Not calculated because only includes ISCED4	Not calculated because only included ISCED8
Austria					
Poland					
Portugal	Not included ISCED0	Not included ISCED0	Only included ISCED1		
Romania	Not included ISCED0	Not included ISCED0	Only included ISCED1		Not included ISCED5
Slovenia				Not included ISCED4	
Slovakia					
Finland					
Sweden					
United Kingdom				Not included ISCED4	

Annex III. Education expenditures on education per student by COFOG level in 2014 (EU28=100). EU countries ordered by current expenditure in PPP in GDP.

COUNTRY	Current expenditure			Compensation of employees						Capital Expenditure		
	PPP in GDP	PPP in AIC	PPP Education	PPP in GDP	PPP in AIC	PPP Education	Order by PPP in GDP	Order by PPP in AIC	Order by PPP Education	PPP in GDP	PPP in AIC	PPP Education
Romania	32	33	67	37	38	78	1	1	3	42	44	90
Bulgaria	41	44	91	41	44	90	2	2	10	84	90	187
Slovakia	59	62	75	65	68	84	5	5	6	30	31	38
Croatia	64	64	87	69	70	95	8	6	14	34	34	47
Lithuania	65	68	111	70	73	121	9	10	24	137	144	236
Latvia	65	66	88	62	64	85	3	3	7	179	184	245
Estonia	65	67	99	65	66	98	4	4	15	98	100	148
Poland	68	74	101	73	80	109	10	12	20	67	73	100
Hungary	73	78	105	69	74	99	7	11	16	75	79	107
Czech Republic	74	79	109	68	73	100	6	7	17	261	278	384
Spain	79	76	83	76	73	80	11	9	4	28	27	29
United Kingdom	88	84	70	76	73	61	12	8	2	127	122	101
Greece	88	88	98	102	102	114	19	19	23	108	108	120
Slovenia	90	89	87	95	93	91	15	16	12	135	133	130
Ireland	91	81	89	97	86	95	17	14	13	77	68	75
France	92	94	92	107	109	107	20	21	19	79	81	80
Finland	96	97	92	87	87	83	13	15	5	154	154	147
Malta	98	98	94	110	109	105	21	20	18	114	113	108
Germany	101	104	95	95	98	90	16	18	9	102	105	96
Portugal	103	101	117	114	111	129	22	22	26	134	131	152
Italy	103	101	111	115	113	124	23	23	25	45	44	48
Denmark	105	101	92	100	96	88	18	17	8	121	117	107
Cyprus	105	106	101	118	119	113	24	24	21	39	40	38
Netherlands	131	128	120	124	121	113	25	25	22	151	148	138
Sweden	137	133	93	88	85	59	14	13	1	74	72	50
Austria	138	137	99	126	125	91	26	26	11	69	69	50
Belgium	154	153	121	171	170	134	27	27	27	112	111	88
Luxembourg	307	273	126	355	315	145	28	28	28	666	591	272

Note: EU28 and Netherlands values are based on 2012.
Source: Eurostat tables gov_10a_exp, educ_enrl1ad and prc_ppp_ind. See Annex II for information about students included in each country.

Annex IV. Expenditure on education per student applying PPP Education with and without QA by ISCED level in 2014

COUNTRY	Primary				Secondary				Tertiary			
	PPP with QA	PPP without QA	Order by PPP with QA	Order by PPP without QA	PPP with QA	PPP without QA	Order by PPP with QA	Order by PPP without QA	PPP with QA	PPP without QA	Order by PPP with QA	Order by PPP without QA
FI	3371.06	3295.94	1	1	7669.48	7498.57	25	25	13640.75	13336.78	27	27
LT	3632.91	3656.72	2	2	6474.95	6517.38	16	16	9188.33	9248.53	22	22
UK	3715.44	3707.63	3	3	5470.67	5459.18	8	8	3853.91	3845.82	3	3
BG	3793.36	3926.35	4	5	8041.37	8323.29	27	27	7794.68	8067.96	16	17
FR	3966.30	3917.41	5	4	7862.31	7765.40	26	26	5329.66	5263.97	7	7
ES	4104.86	4081.63	6	6	6199.71	6164.63	15	15	4363.23	4338.54	5	5
CZ	4313.08	4278.18	7	7	8893.07	8821.11	28	28	8034.18	7969.16	17	16
CY	4355.16	4587.16	8	11	6482.60	6827.93	17	22	6029.41	6350.60	9	10
MT	4399.07	4398.56	9	8	5986.08	5985.38	10	10	8928.93	8927.88	20	21
LU	4551.47	4586.49	10	10	6060.85	6107.47	12	14	n.a.	n.a.		
IE	4619.83	4515.26	11	9	6132.59	5993.77	14	11	7335.77	7169.71	13	12
AT	5073.55	5059.79	12	12	6743.89	6725.61	21	20	3991.89	3981.07	4	4
SI	5112.99	5101.88	13	13	6647.16	6632.71	20	19	7550.98	7534.57	14	15
RO	5260.74	5422.84	14	17	4562.63	4703.22	4	4	7293.00	7517.72	12	14
DE	5327.90	5251.27	15	14	5309.25	5232.89	7	6	8832.13	8705.10	19	18
LV	5345.26	5318.61	16	15	6556.78	6524.10	18	18	5762.38	5733.65	8	8
EL	5385.28	5511.76	17	19	4854.45	4968.46	5	5	3490.91	3572.90	2	2
PL	5532.46	5343.94	18	16	5662.30	5469.35	9	9	10304.01	9952.89	25	24
NL	5661.89	5476.54	19	18	7115.67	6882.73	23	23	10528.22	10183.56	26	25
EE	5857.48	5711.82	20	20	7135.94	6958.49	24	24	9004.21	8780.29	21	20
SK	6211.68	6293.39	21	21	2135.64	2163.73	1	1	4815.29	4878.63	6	6
SE	6614.27	6734.35	22	22	3099.58	3155.86	3	3	8593.87	8749.89	18	19
PT	6883.16	6812.14	23	23	6107.31	6044.29	13	12	7587.22	7508.93	15	13
DK	7169.11	7218.51	24	24	6016.88	6058.34	11	13	10296.21	10367.15	24	26
BE	7630.43	7560.28	25	25	6583.40	6522.88	19	17	6223.73	6166.51	10	9
HU	7676.25	7663.12	26	26	5296.00	5286.94	6	7	9649.03	9632.52	23	23
HR	8148.76	8170.80	27	27	2431.72	2438.29	2	2	6590.23	6608.06	11	11
IT	9146.46	9148.89	28	28	6825.04	6826.85	22	21	3236.38	3237.24	1	1
EU28	**4762.25**				**5947.96**				**6161.53**			

Note: EU28 and Netherlands values are based on 2012.
Source: Eurostat tables gov_10a_exp, educ_enrl1ad (2014) and prc_ppp_ind. See Annex II for information about students included in each country.

List of abbreviations

AIC	Actual Individual Consumption
AICE	Actual Individual Consumption of education
COFOG	Classification of the Functions of Government
ESCS	Economic, Social and Cultural Status
FTE	Full time equivalent
GDP	Gross Domestic Product
ICP	International Comparison Program
ISCED	International Standard Classification of Education
MS	Member States
NPISHS	Non-profit institutions serving households
OECD	Organisation for Economic Co-operation and Development
PISA	Program for International Students Assessment
PPP	Purchasing Power Parity
PPS	Purchasing Power Standards
UOE	Unesco-OECD-Eurostat data collection

Country codes

AT – Austria
BE – Belgium
BG – Bulgaria
CY - Cyprus
CZ - Czech Republic
DE – Germany
DK – Denmark
EE – Estonia
EL - Greece
ES - Spain
FI – Finland
FR - France
HR - Croatia
HU - Hungary
IE - Ireland
IT - Italy
LT – Lithuania
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SK - Slovakia
UK – United Kingdom

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